GENERAL

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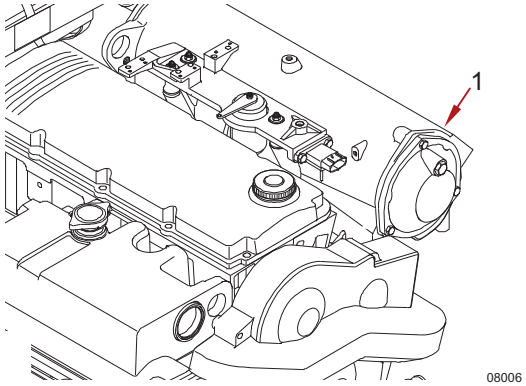
A GENERAL REMARKS

A 1 Model and Serial Numbers

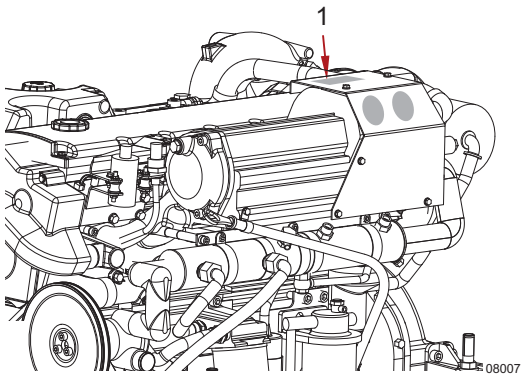
The primary model and serial number (ill.1 or ill.2) is located on the engine as illustrated.
These numbers are required for warranty claims and ordering parts.

FOR ALL
4 CYL. MARINE ENGINES



01.01 .1

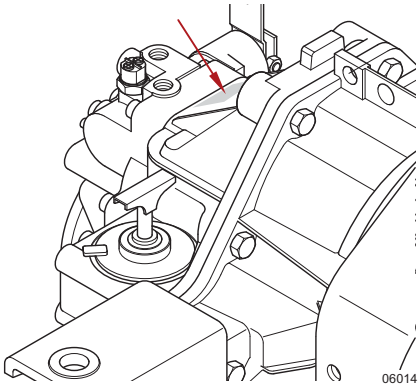
FOR ALL
6 CYL. MARINE ENGINES



01.01 .2

The model and serial number of the marine gearbox is located on the marine gearbox housing as illustrated.

To obtain instructions regarding marine gearbox operation, refer to marine gearbox owners manual.



01.01 .3

A 2 Documentation 4 and 6 cylinder

The following documentation is available in English language on our website:

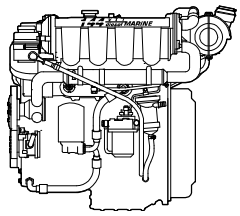
http://www.steyr-motors.com/technical

technical documentation on CD - ROM		P/N Z 001009/0
operation-, maintenance & warranty manual for all marine engines		P/N Z 001022/0
tool catalogue for all marine engines		P/N Z 001002/1
spare parts catalogue	STEYR 94 td diesel marine	P/N Z 001023/0
	STEYR 144 vti/td diesel marine	P/N Z 001005/0
	STEYR 164 td diesel marine	P/N Z 001015/0
	STEYR 174 vti diesel marine	P/N Z 001011/0
	STEYR 166 td diesel marine	P/N Z 011796/1
	STEYR 236 FDE	P/N Z 011796/0
	STEYR 236 td diesel marine	P/N Z 011796/1 - Z011769/2
	STEYR 246 td diesel marine	P/N Z 011800/0
	STEYR 256 td diesel marine	P/N Z 011810/0
	STEYR 266 td diesel marine	P/N Z 011805/0
installation manual for marine engines		P/N Z 001007/0
service manual for all marine engines		P/N Z 001019/0
operator's manual marine gear ZF		P/N Z 001003/0
Diagrams marine engine functions on CD		P/N Z 001021/0

A 3 Modell summary

A 3.1 Modell summary 4 cylinder engines

Bobtail - Version

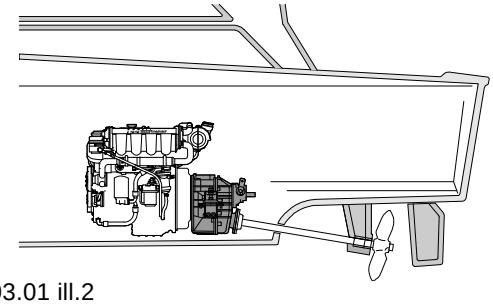


03.01 ill.1

Equipment:
with side mounted raw water pump or,
with side mounted raw water pump, power steering pump

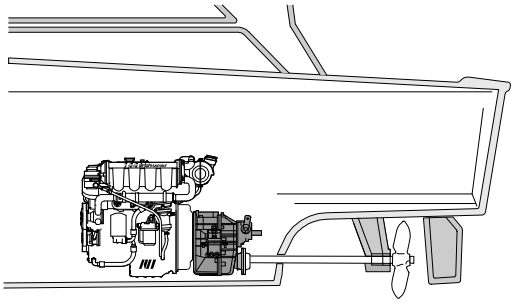
Inborder i.e. ZF 45 Marinegear

Down angle



03.01 ill.2

Innenborder i.e. ZF 63 Marinegear

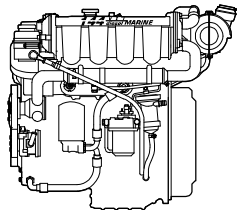


03.01 ill.3

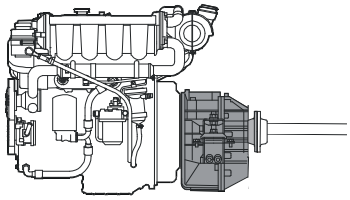
Lifeboat Engine

Equipment

Bobtail "B"

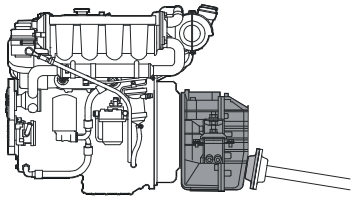


03.01 ill.4



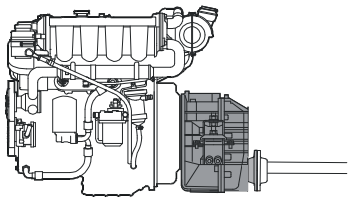
Direkt gearbox

03.01 ill.5



A-down angle gear box

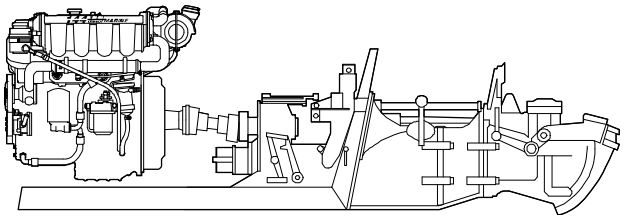
03.01 ill.6



Parallel offset gearbox

03.01 ill.7

Jet Drive



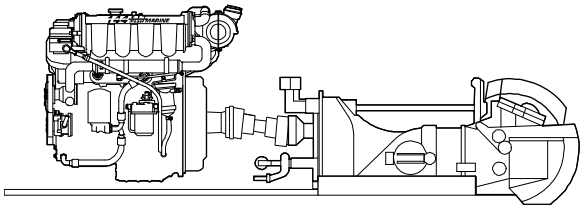
03.01 .8

TYPE

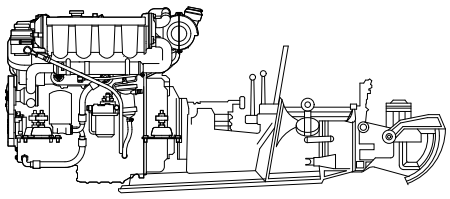
Alamarin

Hamilton

Castoldi

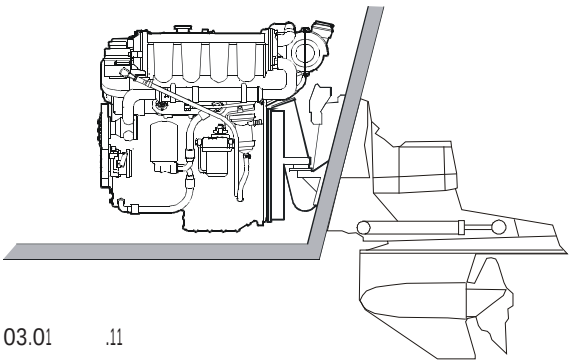


03.01 .9



03.01 .10

Stern Drive



03.01 .11

TYPE

Mercury Alpha Bravo I, II & III

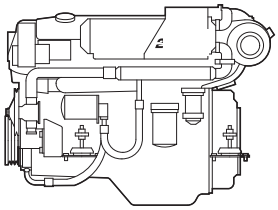
Volvo DP 290

Volvo DP 290 Hydraulic

SX - Stern Drive

A 3.2 Modell summary 6 cylinder engines

Bobtail - Version

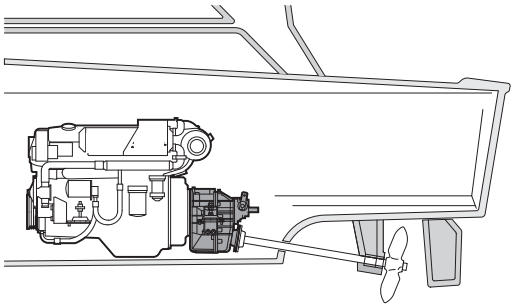


with side mounted raw water pump or,
with side mounted raw water pump, power steering pump and front mounted auxiliary drive-PTO

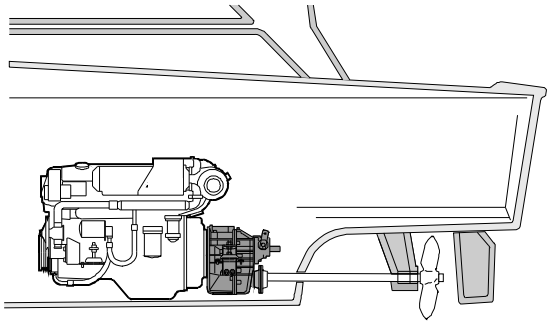
03.02 .1

Inborder i.e. ZF 63 Marine gear

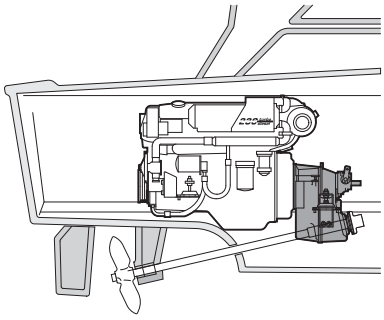
Down angle



03.02 .2



03.02 .3



03.02 .4

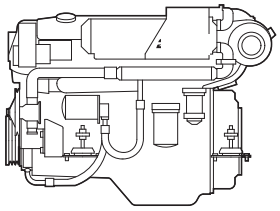
Transmission

i = 2.5V, shaft angle 12°

i = 2.0V, shaft angle 12°

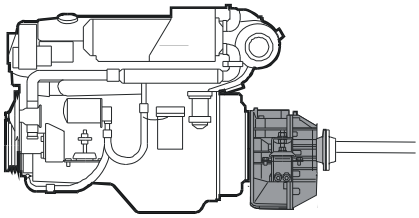
Lifeboat Engine

Equipment



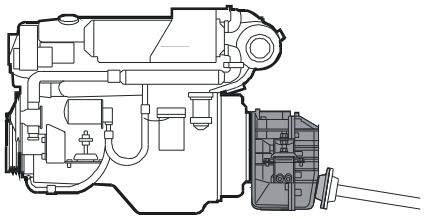
03.02 .5

Bobtail "B"



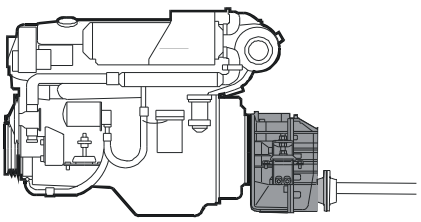
03.02 .6

Direkt gearbox



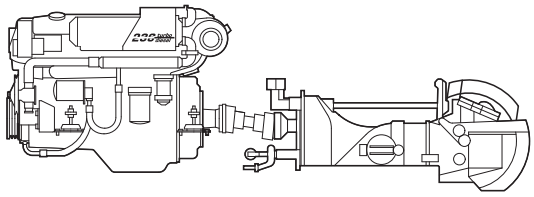
03.02 .7

A-down angle gear box



03.02 .8

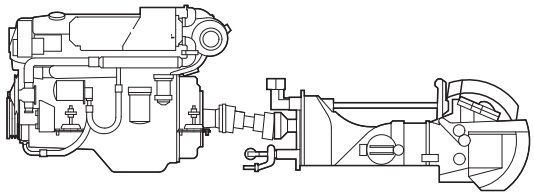
Parallel offset gearbox



Jet drive

03.02 .9

Jet Drive



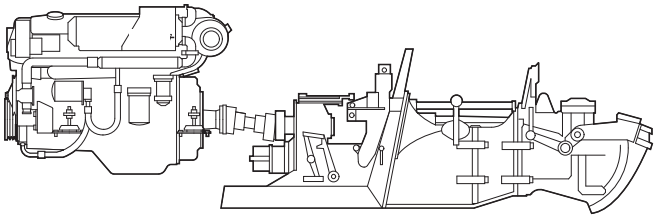
TYPE

Alamarin

Hamilton

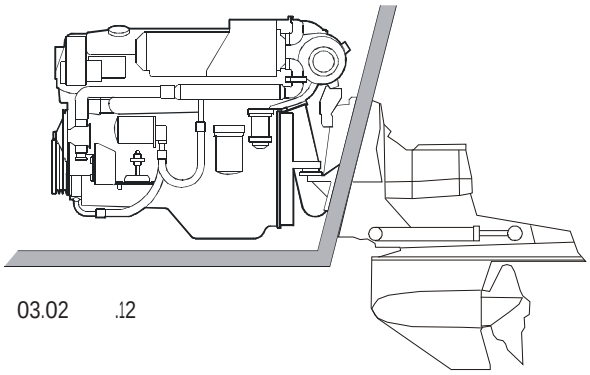
Castoldi

03.02 .10



03.02 .11

Stern drive



Type

Mercury Bravo II & III

Volvo DP 290

Stern Power Drive

Volvo DP 290 ZF
Hydraulic Pump

Volvo SX - Drive
King Cobra Drive

03.02 .12

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A 4.1 Technical data and overview 4 cylinder engines

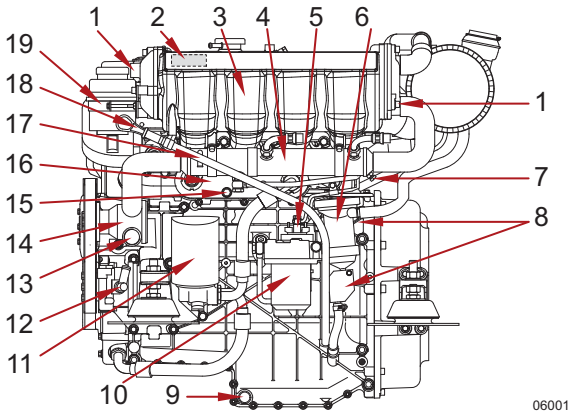
MAKE	STEYR M 14 TCM, TCAM			
type	**MO84K32**	**MO94K33**	**MO114K33**	**MO144V38**
displacement	2133 cm³			
piston displacement	85,0 x 94,0 mm			
rated power acc. EN ISO 8665:2006 (impeller **) KW / HP Jet - Drive / Inboard Z - Drive	 53 / 71 52 / 70	 64 / 86 63 / 84	 78 / 105 77 / 104	 103 / 138 101 / 136
number of cylinders	4-cylinder in-line engine (position of cyl. 1 at vibration damper side)			
ignition order	1 - 3 - 4 - 2			
sense of rotation, seen from front	right			
compression ratio	17,5 : 1			
full-load speed range (rpm)	3000 - 3200	3050 - 3800	3200 - 3800	3600 - 3800
idle speed	650 rpm. (adjustable)			
injection	pump - nozzle with modelling needle control and electronic control			
fuel	acc. to CEC RF-03-A-84 (DIN EN 590) Cetan >49; diesel fuel No. 2-D, temperature above -7°C; No.1-D, temperature below -7°C			
fuel filter	P/No. 2203710/0			
fuel filter location	intake-sided			
air filter	P/No. 2178992/0			
oil pressure above 2000 rpm.	400 - 700 kPa (60 - 100 PSI) microprocessor controlled			
filling capacity motor oil	approx. 8,0 l engine housing (incl. approx. 1 l oil filter contents)			
specification motor oil	SAE 5W-50/ACEA B4-02/API CF or 10W-40/ACEA, E4, E5, E7, API CF / P/N0. Z010058/0			
oil and oil filter change intervals*)	every 150 operating hours and/or once per season			
oil filter	P/No. 2178582/1			
oil filter location	pressure-sided			
electric charging system	14 V / 90 A alternator with transistorized voltage regulator			
cooling system	dual cooling circuit; thermostat-controlled, pressurized cooling circuit; circulating pump with heat exchanger on engine; governor pump, external raw water circuit to heat exchanger			
coolant capacity	11,5 liters			
coolant	STEYR MOTORS engine coolant - 36 C° P/No. Z011785/0			

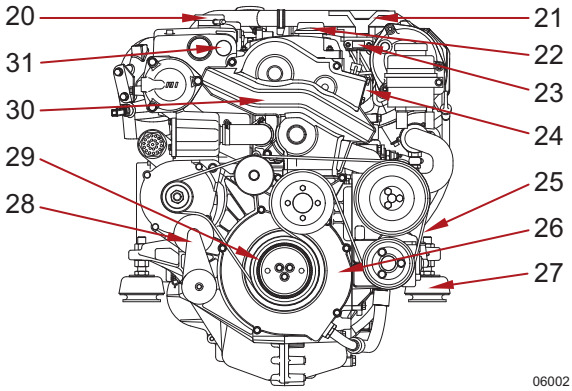
*) extended periods to be evaluated upon application and type of usage
STEYR MOTORS GmbH. reserves the right to make changes without notice or obligations.

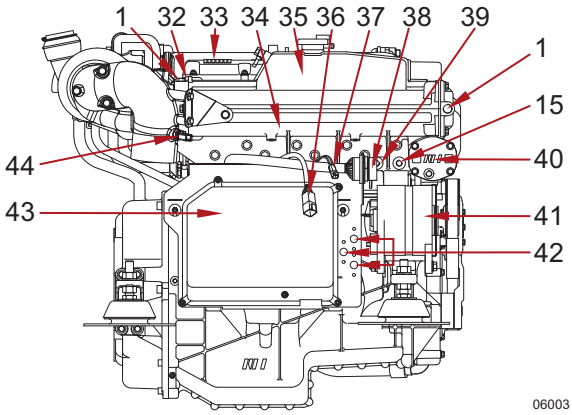
**) Efficiency of gearbox = 97,0%, efficiency of Z-drive = 95,5%

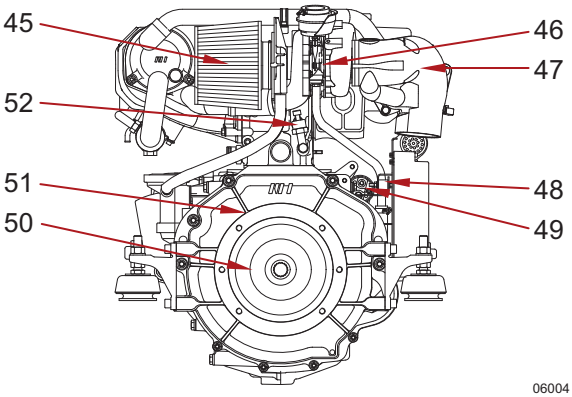
Overview for all STEYR 4 Cyl. Marine Engines

Item	Designation
1	Zinc Anode (4 Units)
2	Model and Serial Number
3	Intercooler
4	Fuel/Oil Cooler with Raw Water Drain Plug
5	Fuel Pump
6	Oil Seperator
7	Raw Water Drain Plug
8	Valve Crankshaft Housing Ventilation (only SOLAS)
9	Oil Drain Plug
10	Fuel Filter
11	Oil Filter
12	Hydraulic Pump
13	Raw Water Inlet Fitting
14	Raw Water Pump
15	Coolant Drain Plug (2 Units)
16	Engine Oilcooler
17	Oil Suction Pipe
18	Oil Dipstick
19	Hydraulic Oil Tank
20	Cooler Cap
21	Potentiometer Accelerator
22	Motor Oil Filler Cap
23	Boost Pressure Sensor
24	Rack Position Sensor *)
25	Drive Belt
26	Cover T-Belt, Lower
27	Engine Mount
28	Drive Belt Tensioner
29	Vibration Damper
30	Cover T-Belt, Upper
31	Engine Lifting Eye
32	Speed Sensor
33	Valve Cover
34	Heat Exchanger
35	Coolant Expansion Tank
36	Diagnostic Outlet
37	Inversion Switch (only for SOLAS)
38	Connector Instrument Panel
39	Coolant Temperature Sensor
40	Thermostat Housing
41	Alternator
42	Circuit Breakers
43	Engine Management System/Fuses
44	Exhaust Temperature Sensor
45	Air Filter
46	Turbo Charger
47	Exhaust Elbow
48	Starter Relais (Backside E-Box Ground Plate)
49	Starter Motor
50	Flywheel
51	Flywheel Housing
52	Oil Pressure Sensor









*) This sensor is magnetism sensitive. All external magnets must be kept away.

MAKE	STEYR M 14 TCAM		
type	**MO144M38**	**MO164M40**	
displacement	2133 cm³		
piston displacement	85,0 x 94,0 mm		
rated power acc. EN ISO 8665:2006 (impeller **) KW / HP Jet - Drive / Inboard Z - Drive	 103 / 138 101 / 136	 116 / 156 114 / 154	
number of cylinders	4-cylinder in-line engine (position of cyl. 1 at vibration damper side)		
ignition order	1 - 3 - 4 - 2		
sense of rotation, seen from front	right		
compression ratio	17,5 : 1		
full-load speed range (rpm)	3700 - 3900	3800 - 4000	
idle speed	650 rpm. (adjustable)		
injection	pump - nozzle with modelling needle control and electronic control		
fuel	acc. to CEC RF-03-A-84 (DIN EN 590) Cetan >49; diesel fuel No. 2-D, temperature above -7°C; No.1-D, temperature below -7°C		
fuel filter	P/No. 2203710/0		
fuel filter location	intake-sided		
air filter	P/No. 2178992/0		
oil pressure above 2000 rpm.	400 - 700 kPa (60 - 100 PSI) microprocessor controlled		
filling capacity motor oil	approx. 8,0 l engine housing (incl. approx. 1 l oil filter contents)		
specification motor oil	SAE 5W-50/ACEA B4-02/API CF or 10W-40/ACEA, E4, E5, E7, API CF / P/N0. Z010058/0		
oil and oil filter change intervals*)	every 150 operating hours and/or once per season		
oil filter	P/No. 2178582/1		
oil filter location	pressure-sided		
electric charging system	14 V / 90 A alternator with transistorized voltage regulator		
cooling system	dual cooling circuit; thermostat-controlled, pressurized cooling circuit; circulating pump with heat exchanger on engine; governor pump, external raw water circuit to heat exchanger		
coolant capacity	11,5 liters		
coolant	STEYR MOTORS engine coolant - 36 C° P/No. Z011785/0		

*) extended periods to be evaluated upon application and type of usage
STEYR MOTORS GmbH. reserves the right to make changes without notice or obligations.

**) Efficiency of gearbox = 97,0%, efficiency of Z-drive = 95,5%

Overview for all STEYR 4 Cyl. Marine Engines

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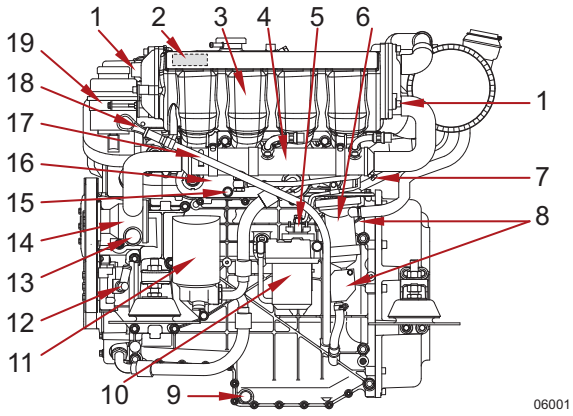
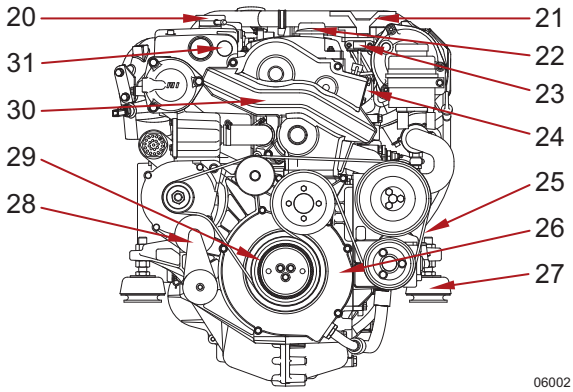
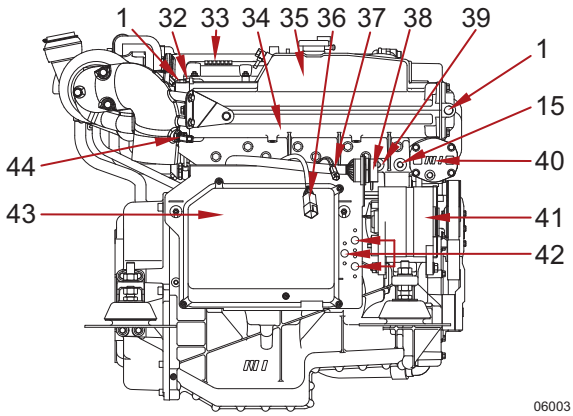
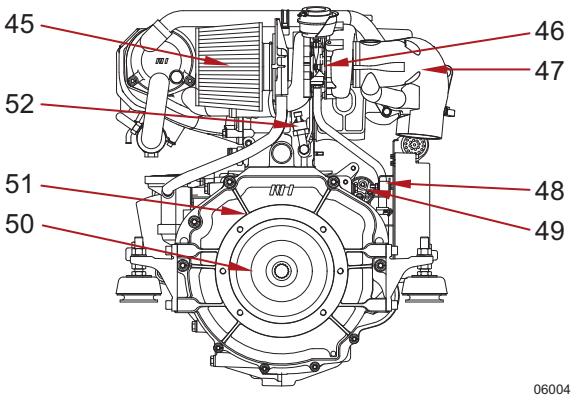
9	Oil Drain Plug
10	Fuel Filter
11	Oil Filter
12	Hydraulic Pump
13	Raw Water Inlet Fitting
14	Raw Water Pump
15	Coolant Drain Plug (2 Units)
16	Engine Oilcooler
17	Oil Suction Pipe
18	Oil Dipstick
19	Hydraulic Oil Tank
20	Cooler Cap
21	Potentiometer Accelerator
22	Motor Oil Filler Cap
23	Boost Pressure Sensor
24	Rack Position Sensor *)
25	Drive Belt
26	Cover T-Belt, Lower
27	Engine Mount
28	Drive Belt Tensioner
29	Vibration Damper
30	Cover T-Belt, Upper
31	Engine Lifting Eye
32	Speed Sensor
33	Valve Cover
34	Heat Exchanger
35	Coolant Expansion Tank
36	Diagnostic Outlet
37	Inversion Switch (only for SOLAS)
38	Connector Instrument Panel
39	Coolant Temperature Sensor
40	Thermostat Housing
41	Alternator
42	Circuit Breakers
43	Engine Management System/Fuses
44	Exhaust Temperature Sensor
45	Air Filter
46	Turbo Charger
47	Exhaust Elbow
48	Starter Relais (Backside E-Box Ground Plate)
49	Starter Motor
50	Flywheel
51	Flywheel Housing
52	Oil Pressure Sensor









*) This sensor is magnetism sensitive. All external magnets must be kept away.

A 4.2 Technical data and overview 6 cylinder engines

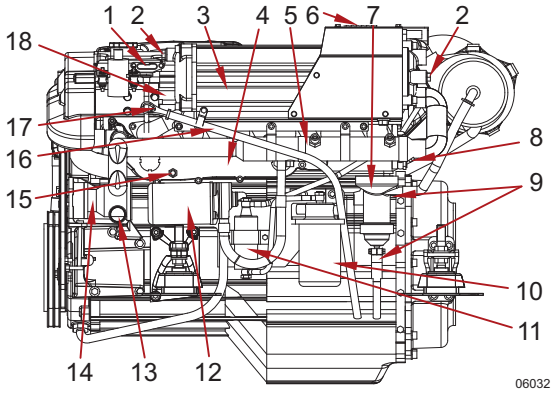
MAKE	STEYR M 16 TCM, TCAM			
type	MO126M28	MO166K28	MO196K35	MO236K42
displacement	3200 cm³			
piston displacement	85,0 x 94,0 mm			
rated power acc. EN ISO 8665:2006 (impeller **) KW / HP Jet - Drive / Inboard Z - Drive	 87 / 117 86 / 115	 116 / 156 115 / 154	 136 / 182 134 / 179	 165 / 221 162 / 218
number of cylinders	6-cylinder in-line engine (position of cyl. 1 at vibration damper side)			
ignition order	1 - 5 - 3 - 6 -2 - 4			
sense of rotation, seen from front	right			
compression ratio	17,5 : 1			
full-load speed range (rpm)	2600 - 2800	2600 - 2800	3300 - 3500	4000 - 4300
idle speed	630 rpm. (adjustable)			
injection	pump - nozzle with modelling needle control and electronic control			
fuel	acc. to CEC RF-03-A-84 (DIN EN 590) Cetan >49; diesel fuel No. 2-D, temperature above -7°C; No.1-D, temperature below -7°C			
fuel filter	P/No. 2177745/1			
fuel filter location	suction-sided			
air filter	MO126 - P/No. 2178992/0; all other 6 Cyl. - P/N 2178992/1			
oil pressure above 2000 rpm.	400 - 700 kPa (60 - 100 PSI) microprocessor controlled			
filling capacity motor oil	approx. 10,0 l engine housing (incl. approx. 1 l oil filter contents)			
specification motor oil	SAE 5W-50/ACEA B4-02/API CF or 10W-40/ACEA, E4, E5, E7, API CF / P/N0. Z010058/0			
oil and oil filter change intervals*)	every 150 operating hours and/or once per season			
oil filter	P/No. 2178582/1			
oil filter location	suction-sided			
electric charging system	14 V / 90 A alternator with transistorized voltage regulator			
cooling system	dual cooling circuit; thermostat-controlled, pressurized cooling circuit; circulating pump with heat exchanger on engine; governor pump, external raw water circuit to heat exchanger			
coolant capacity	13,2 liters			
coolant	STEYR MOTORS engine coolant - 36 C° P/No. Z011785/0			

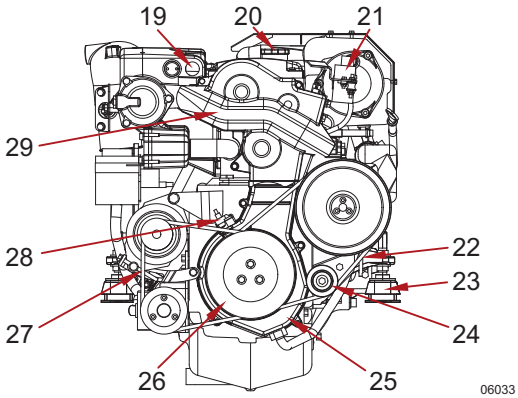
*) extended periods to be evaluated upon application and type of usage
STEYR MOTORS GmbH. reserves the right to make changes without notice or obligations.

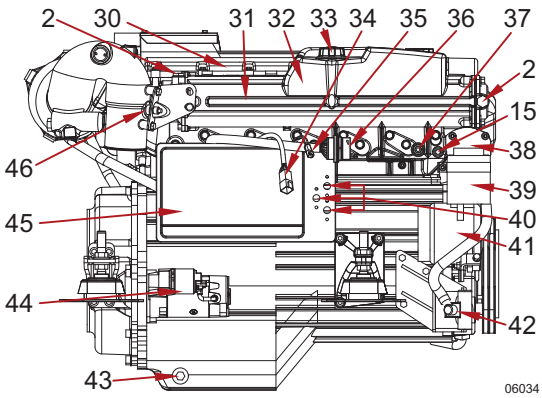
**) Efficiency of gearbox = 97,0%, efficiency of Z-drive = 95,5%

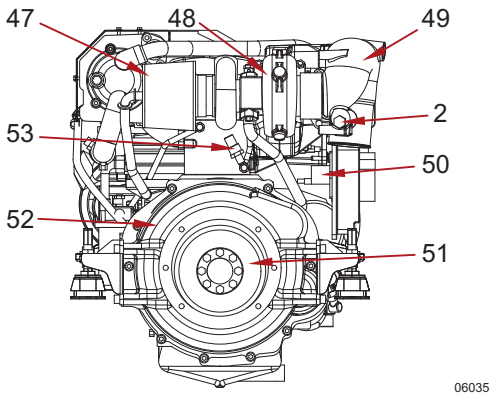
Overview STEYR MO126M28, MO166K28, MO196K35, MO236K42

Item	Designation
1	Boost Pressure Sensor
2	Zinc Anode (5 Units)
3	Intercooler
4	Fuel- / Hydr. Oil Cooler
5	Engine Oilcooler
6	Model and Serial Number
7	Oil Seperator
8	Raw Water Drain Plug
9	Valve Crankshaft Housing Ventilation (only SOLAS)
10	Fuel Filter
11	Fuel Pump
12	Oil Filter
13	Raw Water Inlet Fitting
14	Raw Water Pump
15	Coolant Drain Plug (2 Units)
16	Oil Suction Pipe
17	Oil Dipstick
18	Rack Position Sensor *)
19	Engine Lifting Eye
20	Motor Oil Filler Cap
21	Potentiometer Accelerator
22	Drive Belt, Raw Water Pump
23	Engine Mount
24	Drive Belt Tensioner
25	Cover T-Belt, Lower
26	Vibration Damper
27	Drive Belt, Alternator & Hydr: Pump
28	Speed Sensor
29	Cover T-Belt, Upper
30	Valve Cover
31	Heat Exchanger
32	Coolant Expansion Tank
33	Cooler Cap
34	Diagnostic Outlet
35	Inversion Switch (only for SOLAS)
36	Connector Instrument Panel
37	Coolant Temperature Sensor
38	Thermostat Housing
39	Hydraulic Oil Tank
40	Circuit Breakers
41	Alternator
42	Hydraulic Pump
43	Oil Drain Plug
44	Starter Motor
45	Engine Management System/Fuses
46	Exhaust Temperature Sensor
47	Air Filter
48	Turbo Charger
49	Exhaust Elbow
50	Starter Relais (Backside E-Box Ground Plate)
51	Flywheel
52	Flywheel Housing
53	Oil Pressure Sensor









*) This sensor is magnetism sensitive. All external magnets must be kept away.

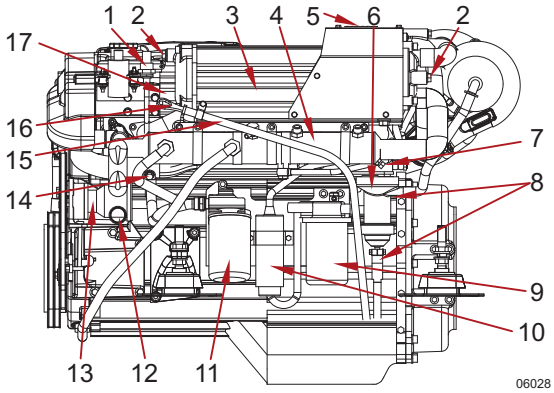
MAKE	**STEYR M 16 TCAM**		
type	**MO256K43**	**MO256H45**	
displacement	3200 cm³		
piston displacement	85,0 x 94,0 mm		
rated power acc. EN ISO 8665:2006 (impeller **) KW / HP Jet - Drive / Inboard Z - Drive	 178 / 239 176 / 236	 178 / 239 176 / 236	
number of cylinders	6-cylinder in-line engine (position of cyl. 1 at vibration damper side)		
ignition order	1 - 5 - 3 - 6 -2 - 4		
sense of rotation, seen from front	right		
compression ratio	17,5 : 1		
full-load speed range (rpm)	4000 - 4300	4000 - 4500	
idle speed	630 rpm. (adjustable)		
injection	pump - nozzle with modelling needle control and electronic control		
fuel	acc. to CEC RF-03-A-84 (DIN EN 590) Cetan >49; diesel fuel No. 2-D, temperature above -7°C; No.1-D, temperature below -7°C		
fuel filter	P/No. 2178992/1		
fuel filter location	suction-sided		
air filter	P/No. 2178992/0	P/No.2178992/1	
oil pressure above 2000 rpm.	400 - 700 kPa (60 - 100 PSI) microprocessor controlled		
filling capacity motor oil	approx. 10,0 l engine housing (incl. approx. 1 l oil filter contents)		
specification motor oil	SAE 5W-50/ACEA B4-02/API CF or 10W-40/ACEA, E4, E5, E7, API CF / P/N0. Z010058/0		
oil and oil filter change intervals*)	every 150 operating hours and/or once per season		
oil filter	P/No. 2178582/1		
oil filter location	suction-sided		
electric charging system	14 V / 90 A alternator with transistorized voltage regulator		
cooling system	dual cooling circuit; thermostat-controlled, pressurized cooling circuit; circulating pump with heat exchanger on engine; governor pump, external raw water circuit to heat exchanger		
coolant capacity	13,2 liters		
coolant	STEYR MOTORS engine coolant - 36 C° P/No. Z011785/0		

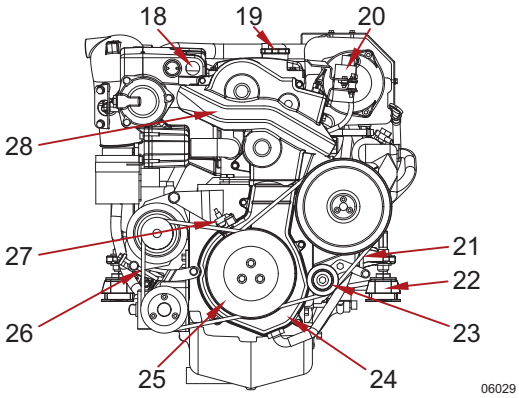
*) extended periods to be evaluated upon application and type of usage
STEYR MOTORS GmbH. reserves the right to make changes without notice or obligations.

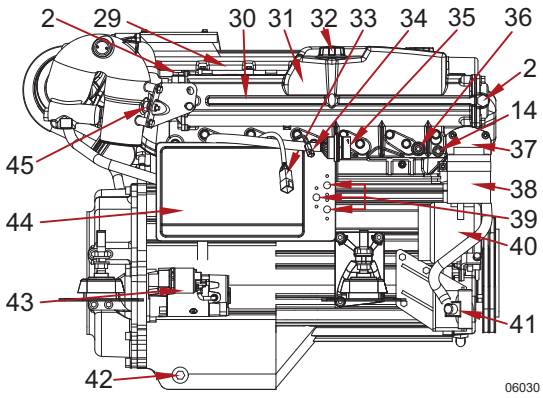
**) Efficiency of gearbox = 97,0%, efficiency of Z-drive = 95,5%

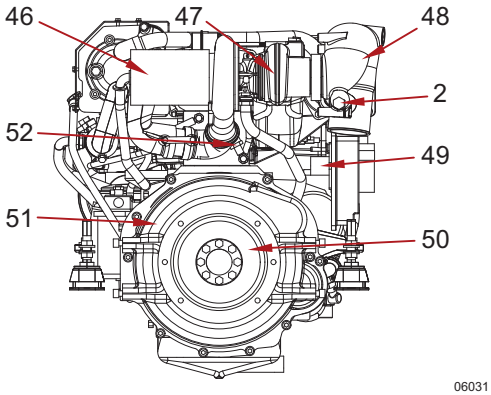
Overview STEYR MO256K43, MO256H45

Item	Designation
1	Boost Pressure Sensor
2	Zinc Anode (5 Units)
3	Intercooler
4	Engine Oil / Fuel / Hydr. Oil Cooler
5	Model and Serial Number
6	Oil Seperator
7	Raw Water Drain Plug
8	Valve Crankshaft Housing Ventilation (only SOLAS)
9	Fuel Filter
10	Fuel Pump
11	Oil Filter
12	Raw Water Inlet Fitting
13	Raw Water Pump
14	Coolant Drain Plug (2 Units)
15	Oil Suction Pipe
16	Oil Dipstick
17	Rack Position Sensor *)
18	Engine Lifting Eye
19	Motor Oil Filler Cap
20	Potentiometer Accelerator
21	Drive Belt, Raw Water Pump
22	Engine Mount
23	Drive Belt Tensioner
24	Cover T-Belt, Lower
25	Vibration Damper
26	Drive Belt, Alternator & Hydr: Pump
27	Speed Sensor
28	Cover T-Belt, Upper
29	Valve Cover
30	Heat Exchanger
31	Coolant Expansion Tank
32	Cooler Cap
33	Diagnostic Outlet
34	Inversion Switch (only for SOLAS)
35	Connector Instrument Panel
36	Coolant Temperature Sensor
37	Thermostat Housing
38	Hydraulic Oil Tank
39	Circuit Breakers
40	Alternator
41	Hydraulic Pump
42	Oil Drain Plug
43	Starter Motor
44	Engine Management System/Fuses
45	Exhaust Temperature Sensor
46	Air Filter
47	Turbo Charger
48	Exhaust Elbow
49	Starter Relais (Backside E-Box Ground Plate)
50	Flywheel
51	Flywheel Housing
52	Oil Pressure Sensor









*) This sensor is magnetism sensitive. All external magnets must be kept away.

B Specifications

B 1 Fuel Requirements

The **STEYR Marine Engines** are designed for maximum fuel economy. To maintain optimum performance use diesel fuel according to CEC RF-03-A-84 or equivalent to meet this specification. When temperatures are below -7° C (20° F), use diesel fuels with additives for low temperature operation.

How to Select Fuel Oil

Fuel quality is an important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels. Direct injected diesel engines are designed to operate on most diesel fuels marketed today. In general, fuels meeting the properties of CEC RF-03-A-84 have provided satisfactory performance. The ASTM D 975 specification, however, does not in itself adequately define the fuel characteristics needed for assurance of fuel quality. The properties listed in the following fuel oil selection chart have provided optimum engine performance.

Fuel Oil Selection Chart

General Fuel classification	**CEC RF-03-A-84 Limit value and units**	**CEC RF-03-A-80 Limit value and units**	**ASTM - Test procedure**
Cetane number	min. 49 - max. 53	min. 51 - max. 57	D 613 (D 976)
Gravity at 15°C (kg/l)	min. 0,835 max. 0845	min. 0,835 max. 0845	D 1298
Destillation 50% 90% End point	 min. 245°C min. 320°C max. 340°C max. 370°C	 min. 245°C min. 320°C max. 340°C max. 370°C	 D86
Flash point	min. 55°C	min. 55°C	D 93
CFPP (Cloud point)	min. -- / max. -5°c	max. -5°c	EN 116 (CEN)
Viscosity Kinematic 40°C	min. 2,5 mm²/s max. 3,5 mm²/s	min. 2,5 mm²/s max. 3,5 mm²/s	D 445
Sulfur content	max. 0,3 mass-%	max. 0,50 mass-%	D 1266/D 2622 D 2785
Cupper corrosion	max. 1	max. 1	D 130
Carbon residue Conradson number (10% residue)	max. 0,2 mass-%	max. 0,2 mass-%	D 189
Ash	max. 0,01 mass-%	max. 0,01 mass-%	D 482
Water content	max. 0,05 mass-%	max. 0,05 mass-%	D 95/D 1744
Acid content (strong acid)	max. 0,20 mg KOH/g	max. 0,20 mg KOH/g	D 974
Oxidation stability	max.2,5 mg/100ml	max.2,5 mg/100ml	D 2274

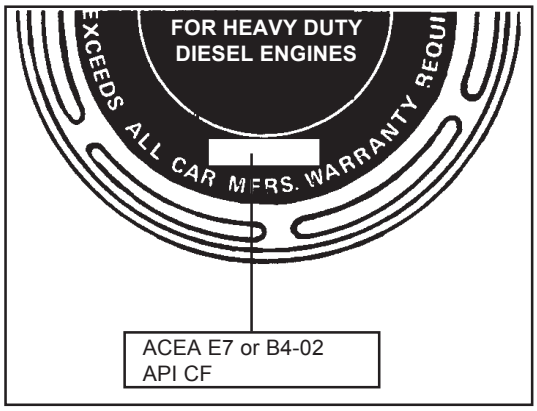
B 2 Motor oil

To obtain the best engine performance and engine life, only motor oils of know manufacturers are to be used, with **ACEA**, API service code and specified SAE viscosity. Refer to oil identification symbol on the container.

Initial filling quantity:	**4 Cyl. engines**	**8,4 Litre** (Oil filling, incl. 1l oil filter)
	6 Cyl engines	**10,4 Litre** (Oil filling, incl. 1l oil filter)
Oil quantity between MIN. and MAX. on dipstick	**2,0 Litre**	
Oil change quantity:	**4 Cyl. engines**	**7,0 Liter** (without oil filter)
	6 Cyl. engines	**9,0 Liter** (without oil filter)
Öil filter:	**ca. 1 Litre**	
Oil - specification, Minimum:	**API:**	**CF or higher**
	ACEA:	**B4 - 02 or higher**
	Viscosity class:	**SYNTHETIC OIL 5W-50**
		SYNTHETIC OIL 10W-40
Recommended engine oil:	**STEYR TURBO DIESEL ENGINE OIL - SAE 10W-40**	
	SMO No. Z010058/0	

Initial factory fill is a high quality break-in oil specified **ACEA B4 - 02, SAE 5W-50**. During the break in period (20 hours), frequently check the oil level. Somewhat higher oil consumption is normal until piston rings are seated. The oil level should be maintained between the minimum and maximum marks on the dipstick. The space between the marks represents approximately 2 quarts (2 litres). For **oil dipstick location**, refer to section **Technical Data and Overview (A 4)**

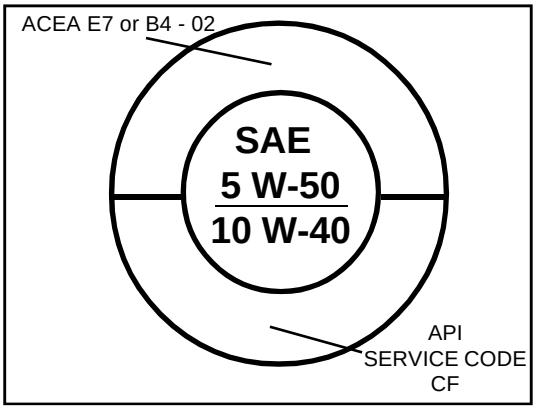
Refer to **Service and Maintenance Chart (C 2)** for recommended oil change intervals.



Oil Identification Symbol

Motor oils are specified by **ACEA**, API service code and SAE viscosity numbers. These may be found on the label, top of can, or oil identification symbol.

NOTE: Some motor oils have several ACEA / API quality ratings.
The recommended ACEA /API service letter code must be among these quality ratings.



02.02 ill.2

ill.1 Top of Can

ill.2 Oil Identification Symbol

C Maintenance and Service

C 1 Trouble Check Chart

ATTENTION:

After following the “Action” described in chart, and before cranking the engine, make sure there are no loose fuel connections. Make sure engine compartment is free of fuel vapours. Failure to do so could result in fire.

SYMPTOM	POSSIBLE CAUSE	ACTION
Engine won’t start	1. No fuel in tank or shut-off valve closed.	Fill tank or open valve.
	2. Air leak in suction lines.	Bleed fuel system and check for leaks.
	3. Fuel line plugged or pump defective.	Fuel pump may be defective.
	4. Poor fuel quality.	Replace fuel .
	5. Water in fuel filter.	Replace or drain water from fuel filter. Check fuel supply for water contamination. If water is present, drain fuel tank and flush with fresh fuel.
	6. System error or failure.	Check Engine Management System display for service code.
	7. Battery output insufficient	Charge or replace battery.
Only for SOLAS ==>	8. Inversion switch actuated	Cancelled by ignition "OFF - ON"
Starter won’t crank engine	1. Battery connections loose or corroded	Check for loose connections and corrosions. Clean connections and thighten.
	2. Battery is dead	Check level of electrolyte and charge battery.
	3. Starter connections loose	Check connections and tighten. If solenoid clicks when attempting to start engine, check starter.
	4. Ignition switch	If inoperative, replace.
	5. Fuse blown on panel	Check and replace if defect
	6. Starter auxiliary relay	Check terminal connection and function of relay.
Engine runs erratically	1. Water, air and/or dirt in fuel filter	Replace filter. Inspect fuel supply line.
	2. Anti-siphon valve stuck	Clean and inspect or replace. (Tank)
	3. Fuel pump	Check operation of pump. Replace fuel pump.

Trouble Check Chart - continued

SYMPTOM	POSSIBLE CAUSE	ACTION
Engine vibrates	Propeller condition Unit injector	Check for bent, broken, or damaged propeller Check for weeds on propeller or sterndrive gearcase. Check for bent propeller shaft. Check.
Engine runs but boat makes little or no progress	Fouled propeller etc.	Check: 1. Propeller for weeds, remove as required. 2. Propeller for spun hub, repair or replace. 3. Hull for excessive marine growth, clean as required.
Performance loss	1. System error or failure. 2. Boat overloaded 3. Boat trim 4. Excessive water in bilge 5. Boat hull condition 6. Improper propeller selection 7. Fuel incorrect 8. Throttle not fully open 9. Overheating 10. Air intake troubles	Check Engine Management System display for service code. Engine coolant temperature; audible alarm. Reduce load. Distribute boat load evenly. Adjust trim. Drain bilge. Cleaning Select proper propeller pitch and diameter. Fill tank with correct fuel. Check fuel filter and fuel flow condition. Check throttle command lever for full travel. Check cooling system. Remove debris from water intake. Check belt tension. Check condition of impeller. Check for clogged heat exchanger tubing (in raw water circuit). Check intake air filter. Check ventilation of engine compartment.
Excessive free play in steering wheel	Steering cable loose	Adjust or replace.
High shift effort	1. Remote control or transom bracket shift cable 2. Remote control binding 3. Engine / drive mechanism sticks	Replace and adjust. Adjust. Center.

C2 Service- and Maintenance Schedule			daily	after first 50 hours or 6 months	every 150 h. or 12 months	every 300 h. or 24 months	*) notes
ENGINE LUBRICATION	check	- for leakage	●				
		- oil level	●				
	change	- oil filter		●	●		
		- motor oil		●	●		
ENGINE COOLING SYSTEM	check	- for leakage	●				
		- fluid level	●				
		- hoses, hose clamps	●				
		- antifreeze temperature condition		●	●		
	change	- antifreeze*)					every 24 month
RAW WATER SYSTEM	check	- hoses, hose clamps	●				
		- zinc anodes		●	●		
		- raw water pump V-belt	●				
		- impeller			●		
	change	- raw water pump V-belt*)				●	if required
		- impeller*)				●	if required
		- zinc anodes*)			●		if corroded > 50%
	preserve	- raw water circuit*)			●		after season
RAW WATER COOLER (OIL-FUEL-AUX.LUBRICANT) for 246 / 256 and 266 only	check	- raw water passages*)			●		clean out desposits in pipelines
	change	- zinc anodes*)			●		required if more than 50% material corroded
AIR FILTER	check	- contamination	●				
	change	- air filter element				●	
	preserve						after season
FUEL SYSTEM	check	- for leakage	●				
		- hoses		●	●		
	drain	- addtiional fuel filter		●	●		
	change	- fuel filter		●		●	
	check	- additional fuel filter		●	●		
	preserve	- fuel system*)					after season
BATTERY	check	- acid level		●	●		
		- densitiy		●	●		
ELECTRONICS	check	- connections*)					after season
ELECTRICAL EQUIPMENT	check	- connections		●	●		tighten loose connections. Renew cables, if required.
		- insulation		●	●		
INVERSION SWITCH	check **(Solas only)**	- switch*)		●			every 50 hours or every 6 months
DRIVING SYSTEM	re-center	- driving unit*)		●	●		see manufacturer's specifications
V-BELT	check	- generator & impeller pump		●	●		adjust tension
		- power-steering		●	●		adjust tension
for all 6 cyl. models	change	- generator*)				●	if required
		- power-steering*)				●	if required
POLY - V - BELT	check	- belt, pulleys and tighteners for wear		●	●		
for all 4 cyl. models	change	- Poly -V-belt					every 1050 hours or every 48 months

Service- and Maintenance Schedule			daily	after first 50 hours or 6 months	every 150 h. or 12 months	every 300 h. or 24 months	*) notes
POLY - V - BELT TENSION	check			●	●		
	lubricate				●		
GLOW PLUGS	change	- plugs*)					every 1500 h. or every 48 months
TIMING BELT	check	- belt tension		●	●		
	change	- timing belt*)					every 1500 h. or every 48 months
		- water pump, tensioner					every 3000 h. or every 48 months
VALVES	check	- valve clearance*)		●			every 750 hours
ENGINE TIMING	check	- set timing					every 750 hours
UNIT INJECTOR	check	- set levers*)		●			every 750 hours
		- set point		●			every 750 hours
		- tighten torque		●			every 750 hours
SERVO PUMP	check	- oil level	●				
		- for leakage	●				
	change	- hydraulic oil (ATF) *)				●	every 750 h. or every 24 months
GEARBOX-STERNDRIVE	check	- oil level	●				
		- for leakage	●				
	change	- gear oil (ATF) *)					see manufacturer's specifications
		- oil filter					
FRONT VIBRA-TION DAMPER	check	- torque		●		●	
ENGINE COM-PARTMENT AND BILGE	check for	- leakage -water	●				repair or consult your STEYR Marine dealer
		-fuel	●				
		-exhaust gas	●				
SHIFTING ⚠	check	- smooth action	●				If required, to be replaced by your STEYR Marine Dealer.
		- adjustment	●				
STEERING ⚠	check	- lubrication	●				see manufacturer´s specification
		- oil level	●				
SAFETY EQUIPMENT ⚠	check	- remote control	●				local rules and consultation of your STEYR
		- emergency cutout	●				
		- completeness	●				
	- condition	●			Marine Dealer		
SHAFT BEARING GLAND	check	- lubrication	●				consult STEYR Marine Dealer
		- sealing	●				
ENGINE MOUNT SCREWS	check	- torque*)		●			every 750 hours
WARNING DEVICE	check	- function		●	●		

D General Information

D 1 Electronic Engine Management System

The **STEYR Marine engine** is equipped with an Electronic Management System (EMS) that performs the following:

* controls engine functions to ensure maximum efficiency.

* self-diagnostic to protect the engine from damage if operating parameter are exceeded.

* stores diagnostic data of EMS server circuits for maintenance and service.

* stores abuse data

Engine power is reduced if:

Operating Parameter	Effect noticed	Panel Indication	Additional Tool-Readings	Action or possible reason
High engine coolant temperature limit exceeded	Reduction of engine speed	Horn ON 2x p. sec. Gauge reading > 107 °C	Steyr Diag Power limitation	See table trouble shooting: Cooling system
Defect - engine coolant sensor or sensor connection	Reduction of engine speed	Horn ON 2x p. sec. Gauge reading > 120 °C	Steyr Diag Service code	Sensor or connector failure; see service code table
Exhaust temperature limit exceeded	Reduction of engine speed	Horn and indication light "CEL" ON 2x p. sec.	Steyr Diag Power limitation	See table trouble shooting: Raw water cooling system
Defect - Exhaust temperature sensor or sensor connection	Reduction of engine speed	Horn and indication light "CEL" ON 2x p. sec.	Steyr Diag Service code	Sensor or connector failure; see service code table
Oil pressure below limit	Reduction of engine speed	Horn continuous and Oil indication light continous switched ON	Steyr Diag Power limitation	See table trouble shooting: Engine oil system
Defect - Oil pressure sensor or sensor connection	Reduction of engine speed	Oil pressure indication light switched ON 1x p. sec.	Steyr Diag Service code	Sensor or connector failure; see service code table
Insufficient boost pressure or defective sensor	Reduction of engine speed		Steyr Diag Power limitation	See table trouble shooting: Air charge system
Engine speed sensor fault	Higher or unstable idle speed, limited performance	No RPM indication on tachometer	Steyr Diag Service code	See table trouble shooting: Speed sensor
Engine speed remains at idle	No increase of engine speed if throttle is moved to max.		Steyr Diag Service code	See table trouble shooting: Accelerator potentiometer failure
Governor position system	Irregular engine speed or stalled engine		Steyr Diag Service code	See table trouble shooting: Governing system

Operating Parameter	Effect noticed	Panel Indication	Additional Tool-Readings	Action or possible reason
Inverse position shut down **(SOLAS)**	Engine shut down beyond 70° deg. angle	After engine stop horn remains switched ON until ignition reset		Reset through ignition OFF and then ON
During break in phase	Cel-ON at high accelerator position (more than 75%)	Indication light "CEL" is switched ON	Steyr Diag Break-in phase	See information break in procedure

Optical and accustical warning signals are explained on the following tables.

"Operating Status and Error Report"

D 2 Diagnostic system

The electronic management system monitors the following engine parameters:
oil pressure, boost pressure, coolant temperature, exhaust pipe temperature (Hi-riser), sensor control rack, potentiometer accelerator, speed signal

The electronic management system carries out self-diagnostic and/or plausibility checks for all input values and sensor connections. In case of irregularities, there is an optical or audible warning signal. (see page 71)

Existing active failures remain stored until the problem has been solved and the code has been cleared from the memory.
To select stored error codes, a PC with diagnostic program (VR00134/0) or diagnostic tool (VR00135/1) is necessary.

Malfunction during operation is ranked in three different categories intermittent failure, non essential failure and essential failure.

D 3 Extended Storage Preservation Procedure

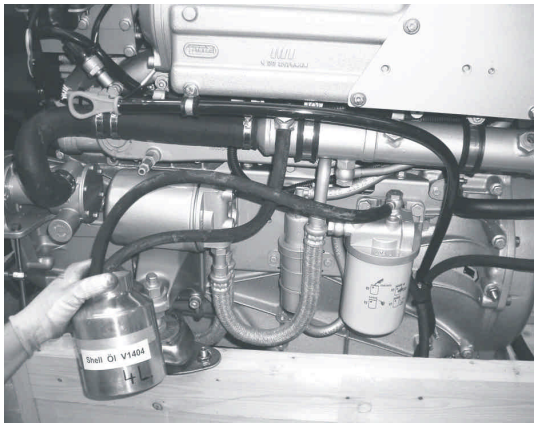
1 Remove the engine from storage and place on a suitable work shop floor with access to all side of the engine. Do not remove from the original packing pallet.

2 Start the engine and let it run up to temperature.

3 Stop the engine and drain the old engine oil and store for future refill and usage.

4 Fill in preservation oil Shell Ensis Engine Oil 30 (part number Z050323/0-5 litres) up to the minimum mark on the dip stick.

5 Connect the fuel system to a tank or canister filled with Shell oil V1404 (part number Z010014/0 - 5 litres). See ill. 1



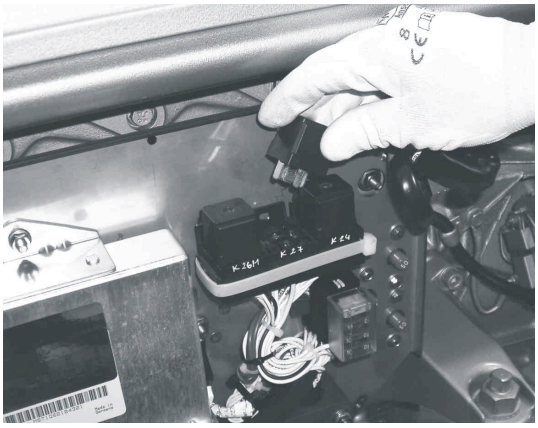
ill.1

6 Restart the engine and allow to run in idle for 5 minutes.

7 Disconnect the fuel feed line from the engine and turn the ignition on, the fuel pump runs for 10 sec automatically emptying the fuel system. Repeat until no more fuel comes from the return line.

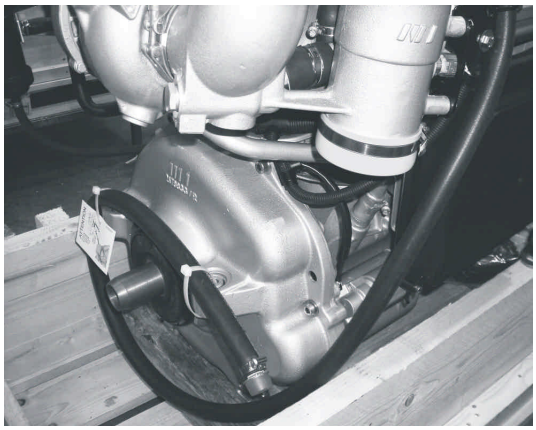
8 Either drain the preservation oil from the engine and replace with normal oil (as per Service Bulletin AS_7004) and store for future use. Alternatively leave it in the engine for future preservation work. The preservation oil has a shelf life of also 3 years and may be used any number of times within this period. It is important to note that an engine may never be sold on or installed with this oil in as this will lead to severe engine damage if run for extended periods

9 Remove the main relay K27; this will stop fuel being injected and therefore the engine from starting. See ill. 2



ill.2

10 Remove the air filter, plug the exhaust elbow and remove the inlet pipe to the tandem/triple cooler, see photo. See ill. 3 and ill. 4



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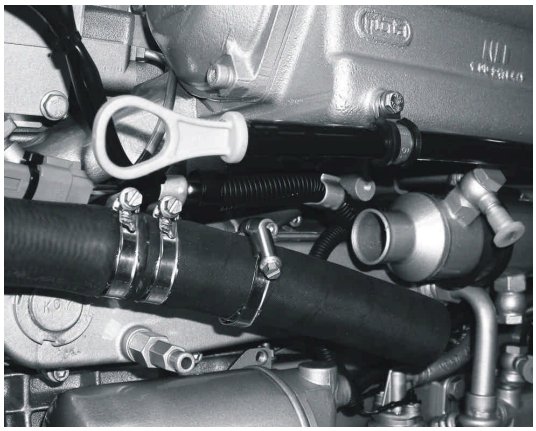


ill.4

11 Fill a spray bottle with the preservation oil Shell Ensis Engine Oil 30 part number Z050323/0.

12 Whilst cranking the engine over, by turning the start key, spray the preservation oil into the turbo inlet. See ill. 5

13 Continue this process for 20 to 30 seconds.

14 Refit the fuel feed line to the engine and turn the ignition on, the fuel pump runs for 10 sec automatically refilling the fuel system. Repeat until fuel comes from the return line.

15 Replace all pipes and connections to original condition and re-store engine.

ill. 5

16 The engine is now preserved for one more year.

This preservation procedure must be done every year and ensures that all of the air ways systems, raw water systems, oil system and the cylinders are protected against corrosion. This procedure is repeatable up to a maximum of three times, giving a shelf life of up to four years.

NOTE: When commissioning or running an engine that has been preserved as stated above the engine will run roughly and smoke for the first few minutes. Do not be alarmed as this is normal until the deposits of the preservation materials have cleared.

D 4 Engine Break-In procedure

The following procedure must be used on new and rebuilt STEYR Diesel Engines. You must follow the Engine Break-In instructions during the first 20 running hours to ensure maximum performance and longest engine life.

NOTE: NONOBSERVANCE OF BREAK-IN INSTRUCTIONS MAY CAUSE SEVERE ENGINE FAILURE.

First Two Hours

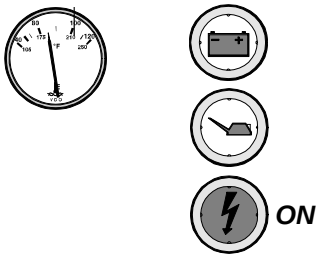
For the first five to ten minutes of operation, run engine at a fast idle (below 1500 RPM). For the remaining first two hours of operation, accelerate to bring boat onto plane quickly and bring throttle back to maintain a planing attitude. During this period, vary the engine speed frequently by accelerating to approximately three-fourth throttle for two to three minutes, then back to minimum planing speed.

When the engine has reached operating temperature, reduce engine speed, then increase engine speed again, to assist the break-in of rings and bearings. Maintain planing attitude to avoid excessive engine load.

NOTE: DO NOT RUN ENGINE AT A CONSTANT RPM FOR LONGER PERIODS DURING THIS INITIAL TWO HOURS OF BREAK-IN.

ATTENTION: Warning indication engine over load during break - in via ECU

The ECU controls during the first two hours of engine operation the load on the engine and alarms the drive by the "Check Engine Light", if much power is demanded from the new engine.



In case the operator get alert, when running the engine during break in phase, by this "Break - In" warning indication (CEL light - ON), the throttle position must be reduced until this signals are extinguish.

Next Eight Hours

For the next eight hours, continue to run engine at approximately three-fourth throttle or less (minimum planing speed). Occasionally reduce throttle to idle speed for cooling down. During this eight hours of running it is permissible to run at full throttle for periods of less than two minutes.

NOTE: DURING BREAK-IN, DO NOT RUN ENGINE AT A CONSTANT RPM FOR LONGER PERIODS.

Final Ten Hours of Break-in

During the final ten hours of break-in, the engine may run at full speed for five to ten minutes. After warming up the engine to operating temperature, momentarily reduce the engine speed and then increase it again. For cooling down the engine, occasionally reduce the engine speed.

NOTE: DURING THE BREAK-IN PERIOD, THE ENGINE MUST NOT BE OPERATED AT CONSTANT RPM FOR LONGER PERIODS.

During break-in period, be particularly observant of the following:

A. Check motor oil level daily. Always maintain oil level in the desired range between the "MIN" and "MAX" marks on dipstick.

When refilling motor oil, refer to information "**Motor Oil"** (B 2).

B. Check oil pressure control lamp. If the lamp lights up as soon as the boat changes its position (while turning, raising the boat or planing), check the oil level in the engine housing by means of dipstick. If necessary, add oil (**DO NOT OVERFILL)**. In case that the oil pressure control lamp still illuminated with correct oil level, have the engine checked by your STEYR Marine dealer as to malfunction of signal or oil pump.

NOTE: During normal operation of engine, oil pressure will rise as RPM increases and fall as RPM decreases. In general, oil pressure will be higher with cold motor oil and specific RPM than with hot motor oil.

C. Check engine temperature indication. Normal operation between 80° - 95°. In case of audible alarm, check coolant level in expansion tank (only at cold engine).

D. Deviations from normal operating conditions will be indicated by warning lights and audible alarm. As to exact meanings see 06.07.02 & 06.07.05.

ATTENTION: <u>In case of nonobservance of break-in instructions, warranty will expire.</u>

Engine to be filled with recommended oil quality only. See chapter "Engine Lubrication"

D 5 Operation after Break - In

The engines specified in this manual are intended to be operated at different speeds and loads, but not allowing full load of the engine for more than one hour per 12 running hours. Economic driving may be achieved at the following speeds:

M084K32	**3000 rpm.**
M094K33	**3000 rpm.**
M0114K33	**3000 rpm.**
M0144M38 + BUKH STEYR SOLAS	**3200 rpm.**
M0144V38 + BUKH STEYR SOLAS	**3200 rpm**
M0164M40 + BUKH STEYR SOLAS	**3400 rmp**

M0126M28	**2200 rpm**
M0166K28	**2200 rpm**
M0236K42 + BUKH STEYR SOLAS	**3300 rpm**
MO256K43	**3600 rpm**
MO256H45	**3600 rpm**

which will prolong engine life and reduce sound emissions.
When starting a cold engine, always allow the engine to warm up slowly. Never run the engine at full speed until operating temperature is reached. During the first 50 running hours, check the oil level frequently.

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E QUALITY GUIDELINES FOR REPAIR

E 1 Spart part specification

Your **STEYR marine engine** was designed for marine operation which means operating conditions such as:

* Long-time operation at high speed

* Operation in salt or brackish water

* Operation in very muddy water

Only use genuine STEYR MARINE spare parts in order to avoid possible loss of performance. For this reason you should insist on the famous quality of genuine STEYR MARINE spare parts and under no circumstances use spare parts of unknown quality.

E 2 Workshop profile

Independently of the respective repair steps and the legal regulations the workshops have to meet the following requirements:

- Clean, dry, and dustfree environment
- Lifting gear (crane) with a lifting capacity of 5 000 N (500 kg) minimum
- Cleaning device (wash basin) for soiled components
- Commercial tools
- Appropriate test and measuring equipment
- Receptacles for operating agents.

Depending on the repair step to be carried out, the tools indicated in the catalog TOOL KIT are to be provided.

Furthermore special care is to be taken in case of purchasing and stock of required operating material, spare parts and wear parts (e.g. seals, filters, anodes,...).

For appointed retailers and authorized workshops of STEYR MOTORS GmbH, the following minimum standard is to be met:

- basic training (as soon as possible, after conclusion of contract, for trade and workshop)

- biannual training (reacurring)

- tool kit I (service and maintenance tools)

- tool kit II - III (depending on repair to be carried out)

- procurement and stock of required genuine spare parts (as per proposed spare parts)

- spare part catalogue for all STEYR MARINE ENGINES models

- technical literature

- PC diagnostics

E 3 Nomenclature

Term	Description	Example
disassemble remove unscrew deflange dismantle	Removal of an assembly of a main assembly or of a component of an assembly without other assemblies having been removed before	
assemble put on, place screw on flange mount	Putting on of an assembly on a main assembly or a component of an assembly without further assemblies being put on for functional performance	
disconnect	Separating of connections of lines, pipes and hoses, which are separable	
connect	Putting together separable connections of lines, pipes and hoses	
pull off	Removal of a component with press fit from another	
press on	Placement of a component with press fit to another	
unscrew	Opening of turnable locks	
tighten	Closing of turnable locks	
disassemble	Removal of an assembly from a main assembly or a component from an assembly, if other assemblies have been removed before	
assemble	Putting on an assembly to a main assembly or a component of an assembly, if further assemblies are put on for functional achievement	
loosen	Partial unlocking of fixing elements of a component or of an assembly	
remove	Taking off a fixing element of a component or an assembly	
secure	Putting on a fixing element of a component or an assembly and tightening	
disassemble	Taking apart assemblies into individual components	
assemble	Putting together components to an assembly	
adjust readjust	Elimination of a deviation by means of provided equipment or Devices or tools	Valve clearance, start of feeding operation
refill	Adding and replenishing of operating agents	
renew	Replacing an auxiliary material by a new one	Corrosion protection agent, sealing material, paint
gauge	Reading in actual positions in programming memory	
replace	Exchanging of a device, a main assembly, an assembly or a component by the same, new or repaired ones	
measure	Steps taken to determine the actual status by evaluating of physical entities	
check	Steps taken to compare the actual status with a determined	Valve lift, piston diameter, valve clearance, close fit, V-belt tension
clean	Removal of foreign and auxiliary material	
maintain	Steps taken to keep the respective determined planned status	

E 4 SI- System

The following measuring units are used.

Linear

km	=	kilometer
m	=	meter
mm	=	millimeter
"	=	inch

Area

m^2	=	square meter
cm^2	=	square centimeter

Volume

m^3	=	cubic meter
cm^3	=	cubic centimeter
dm^3	=	cubic decimeter
mm^3	=	cubic millimeter
l	=	litre

Mass

t	=	metric ton
kg	=	kilogram
g	=	gram

Energy

N	=	newton
kN	=	kilonewton
daN	=	dekanewton

Electricity

A	=	ampere
V	=	volt
W	=	ohm
µF	=	microfarad

Fuel consumption

g/kWh	=	gram per kilowatt hour

Pressure and Stress

bar	=	bar
Pa	=	pascal
KPa	=	Kilopascal
N/mm^2	=	newton per square millimeter

Energy

J	=	Joule
kW/h	=	kilowatt hour

Power

kW	=	kilowatt

Temperature

K	=	degrees Kelvin
° C	=	degrees Celsius

Time

h	=	hour
min	=	minute
s	=	second

Velocity

km/h	=	kilometer per hour
m/s	=	meter per second

Speed

1/min	=	r.p.m.

E 5 Abbreviations

ill.	illustration
Cu	copper
MAssy	main assembly
max.	maximum
TDC	top dead center
PTO	(POWER TAKE OFF) power transmission at front crankshaft end
WS	wrench size
EMS	Electronic Management System
ECU	Electronic Control Unit

F OPERATING MATERIAL AND INFORMATION ON DISPOSAL

F 1 List of operating material

Order No.	Qty.	Designation
VR00207/0	1	set of fuel and oil for engine service, consisting of:
Z010058/0	3	- STEYR Turbo Diesel motor oil SAE 5W-50 (4l. can.)
Z011785/0	3	- STEYR MOTORS engine coolant (5l. can.)
9000190/0	2	- hydraulic oil ATF (1l. bottle)
Z012222/0	1	- grease, Never - Seez; NS-160 B (1 kg can.)
Z909570/0	1	- caoutchouc sealing / electric contacts (148 ml can.)
9000059/1	1	- thread protection 243 (10 ml flask)
9000297/1	1	- surface sealing 509 (315 ml cartridge)
9000510/5	1	- surface sealing 5910 (50 ml cartridge)
9000019/1	1	- construction adhesive 620 (50 ml flask)
9000017/1	1	- construction adhesive 262 (50 ml flask)
Z010207/0	1	- contact grease (100 ml tube)
Z010226/0	1	- corrosion protection spray (400 ml can.)
Z010227/0	1	- corrosion protection wax (120 ml can.)
Z010084/0	1	- grease STABURAX NBU4 (1 kg can.)
Z010205/0	1	- fuel rust protection additive (5 lt can.)
9000197/0	1	- electric contact spray
Z011627/0	1	- silver varnish, RAL 9006 (1 lt can)
Z010074/0	1	- hardener varnish (0,5 lt can)
Z010075/0	1	- dilution for varnish (5 lt can)

F 2 Disposal of automotive waste products

Used operating material is to be collected in special containers to enable possible subsequent treatment.

ATTENTION: All operating materials for the engine are subject to the Special Waste Act for disposal. The "Special Waste Catalog" ÖNORM S 2100 refers to the required disposal in Austria. Respective legal local regulations are to be followed.

The maintenance and repair personnel has to take care that operating material and other material to be regarded as special waste product, is always deposited at collection site.

Key-No.:	Description
31 423	Oil contaminated soil or oil bonding agent
54 102	Waste oil
54 104	Fuels
54 202	Lubricants
54 207	Vaseline
54 917	Solid sealing material
54 927	Oil soiled cleaning rags
54 928	Used oil and air filters
55 510	Paint and varnish containing waste material

G NOTES ON SAFETY

G 1 General notes on safety

The general knowledge and training of the personnel and the contents of the "general regulations of safety technology" and machine safety regulations (Maschinen-Sicherheitsverordnung - MSV) are not subject of this chapter.

Inappropriate behaviour and insufficient knowledge of hazard during repair works may cause injury to persons.

In the description of repair works, such sources of danger are marked with

ATTENTION

The personnel is to be trained accordingly and requested to follow the saftey rules.

G 2 Guidelines for damage prevention

The general knowledge and training of the workshop personnel and the contents of the "general regulations of safety technology" and machine safety regulations (Maschinen-Sicherheitsverordnung - MSV) are not subject of this chapter.

Inappropriate behaviour and insufficient knowledge of hazard during repair works may cause injury to persons.
In the description of repair works, such sources of danger are marked with

ATTENTION

While handling with operating materials, take care that these are not applied to visible surfaces. Lubricants should form a thin film on the surface, surplus lubricants are to be wiped off.

G 3 Legal rules

The following rules and guidelines are valid in Austria. For other countries, follow the local regulations.

Maschinen - Sicherheitsverordnung - MSV (machine safety regulations)

G 4 Safety in the use of operating material

Dangerous operating material, in the sense of accident prevention, are all operating materials potentially explosive, fire-provoking, easily flammable, poisonous, injurious to health and corrosive.

Especially the following material belong to this group:
- Spirit
- Mineral oils
- Battery acid
- Anti-freeze agent
- Varnishes and diluents
- Solvents
- Fluid seals and nut locks

In case of fire of operating material do not try to extinguish the fire with water. Use carbon dioxide extinguisher or powder extinguisher. Contact fire brigade.
When operating material is spilled, e.g. in case of refueling, it is to be absorbed by sand, soil or an appropriate bonding agent and to be disposed.

ATTENTION: In order to prevent health hazards, take care of the following:

- Avoid direct contact with dangerous operating material, as far as possible.
- Change clothes as quickly as possible, if they are soiled with dangerous operating material.
- Do not keep oily rags in work clothes.
- Clean oil soiled body parts only with products friendly to skin (never use rubbing sand or solvents).
- Never fill operating agents in beverage bottles.

G 5 Measures in case of accidents

Products	First Aid		
	Skin	Eyes	Swallowing
Diesel fuel and mineral oils Lubricants Anti-freeze agents Brake fluid Battery acid	Remove clothes and clean skin thoroughly with water and soap	Rinse thoroughly with water for at least 10 minutes. SEE A DOCTOR!	DO NOT VOMIT The biggest danger after an accidental intake is the fact that liquid could get into lungs by aspiration. DO NOT PROVOKE VOMITING AND IIMMEDIATELY SEE A DOCTOR

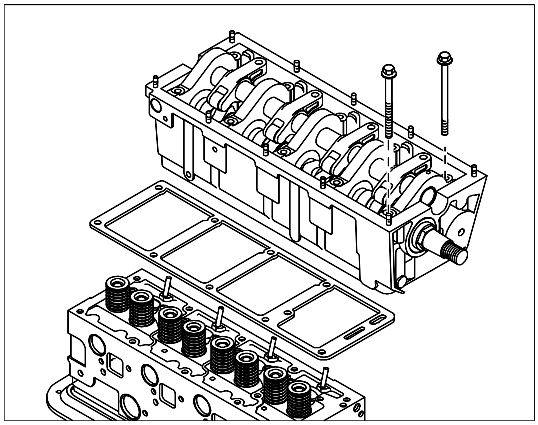
H Tightening Torques

H 1 Listing of Tightening Torques

Camshaft Housing
Screw joint to cylinder block

1. step: **15 Nm +/- 2**
2. step: **25 Nm +/- 1**

Tighten screws of camshaft housing in two steps in precedence of numbering on bearings (from the inside outwards).



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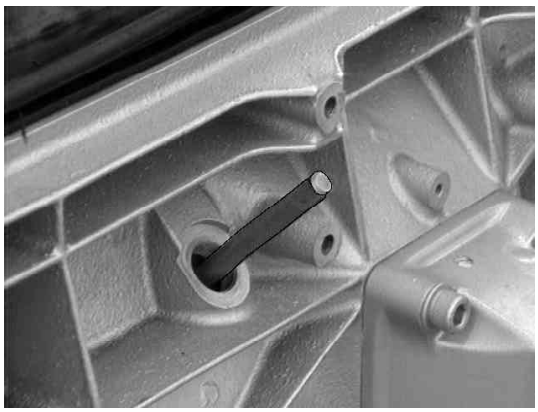
Plug screw for locking pin
in engine housing

50 Nm +/- 5



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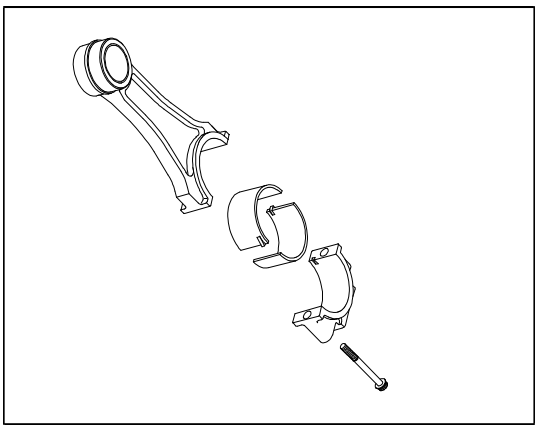
Connecting rod screws
(apply oil to thread and screwhead support)

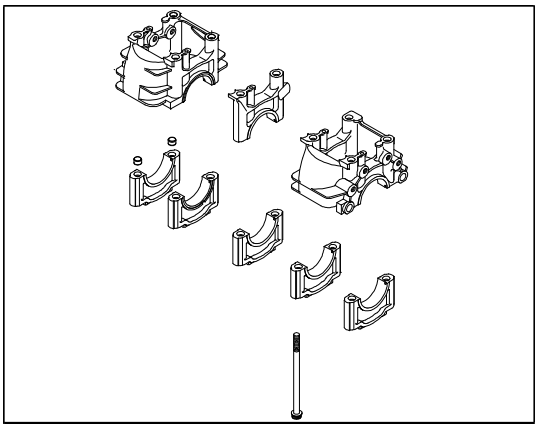
1. step: **10 Nm +/- 1**
2. step: **30 Nm +/- 3**
3. step: **75° +/- 4°**



08.01 ill. 3

Main bearing screws
(apply oil to thread and screwhead support)

1. step: **35 Nm +/- 3**
2. step: **45° +/- 4°**
3. step: **45° +/- 4°**



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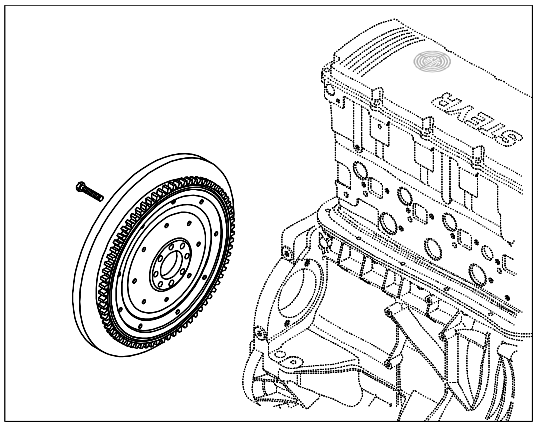
Flywheel screws
(use LOCTITE 243 on thread)

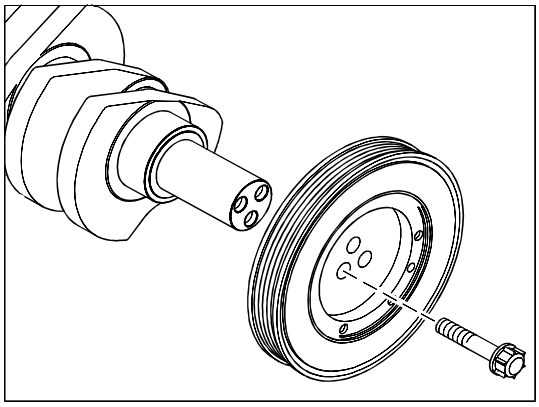
75 Nm +/- 4



08.01 ill.5

Vibration damper screws
(apply oil to thread and screwhead support)

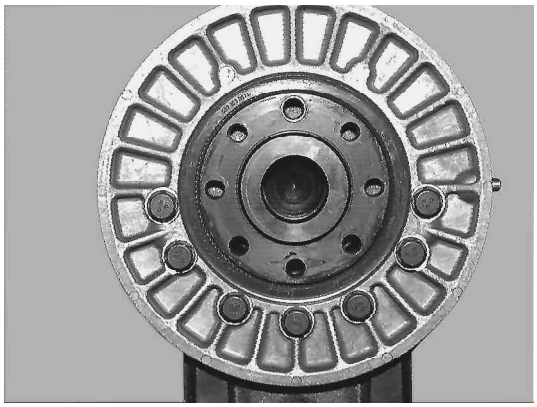
135 Nm (2x) +/- 7



08.01 ill.6

Screw, rear ring carrier
(use LOCTITE 243 on thread)

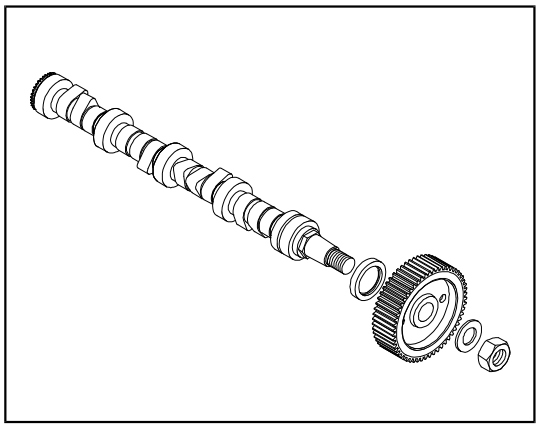
1. step: **8 Nm +/- 1**
2. step: **30 Nm +/- 3**



08.01 ill.7

Nut, camshaft sprocket
(taper degreased on camshaft, thread lubricated)

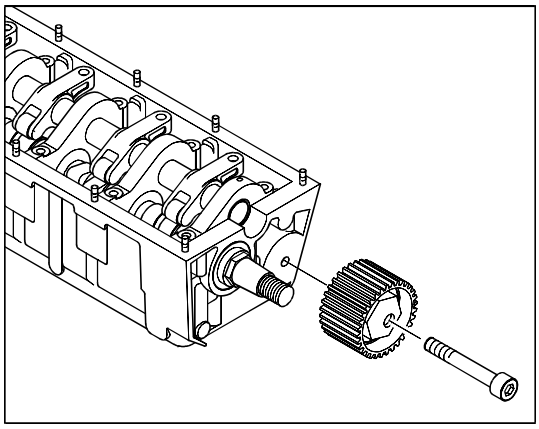
1. step: **80 Nm +/- 4**
2. step: **240 Nm +/-12**



08.01 ill.8

Screw tooth, belt tensioner

45 Nm +/- 4



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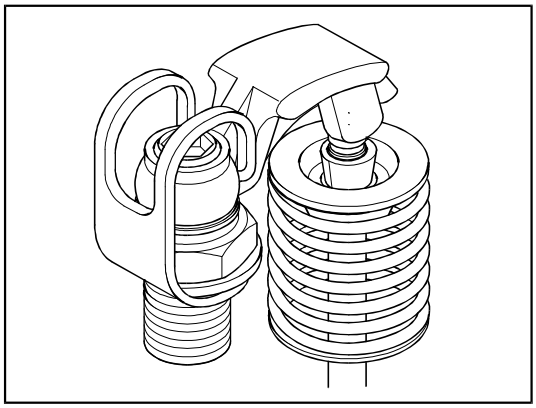
Valve adjustment element

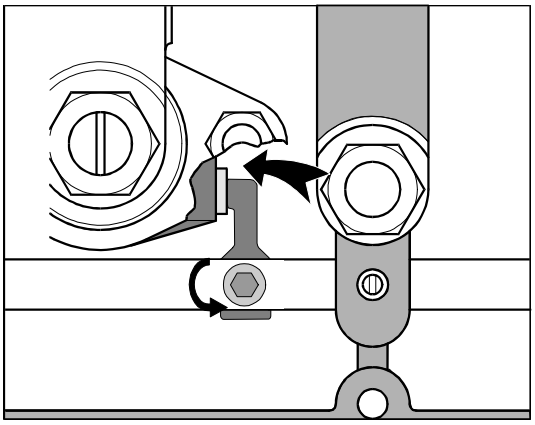
55 Nm +/- 3



08.01 ill.10

Screw, linkage lever
CAUTION: left-hand thread

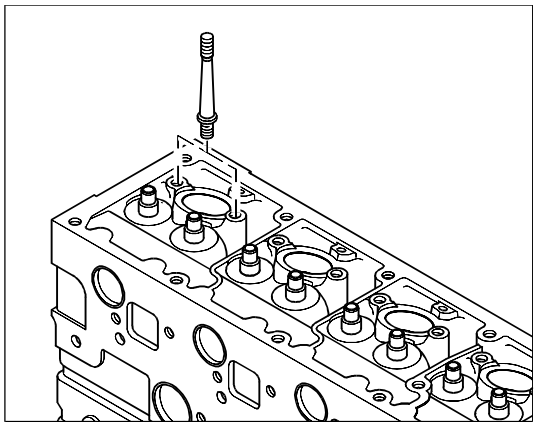
7 Nm +/- 0,5



08.01 ill.11

Stud, unit injector

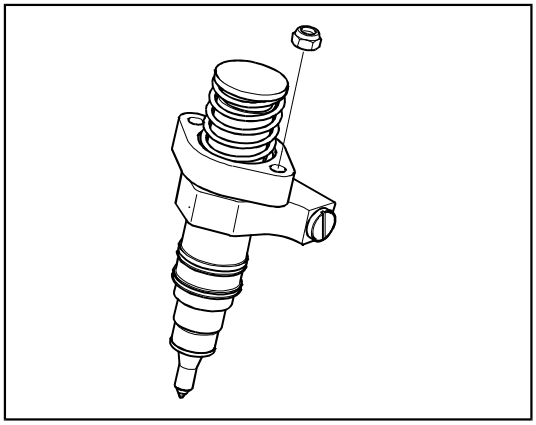
21 Nm +/- 2



08.01 ill.12

Collar nut for unit injector

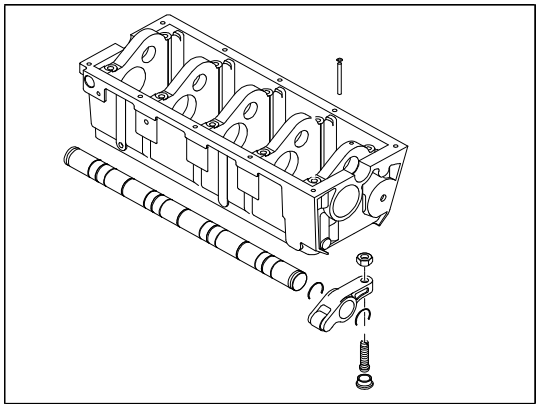
18 Nm - 2



08.01 ill.13

Nut, adjustment screw of unit injector

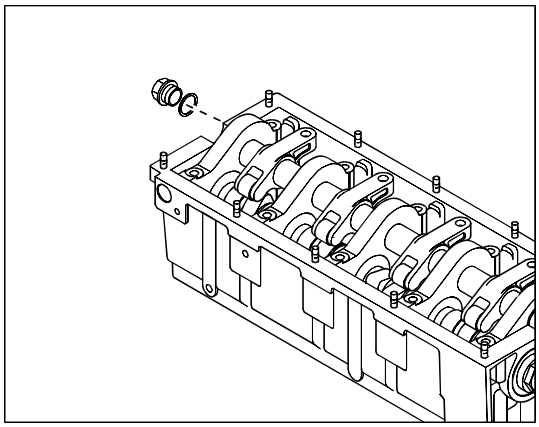
30 Nm +/- 3



08.01 ill.14

Plug screw for control rack
in camshaft housing

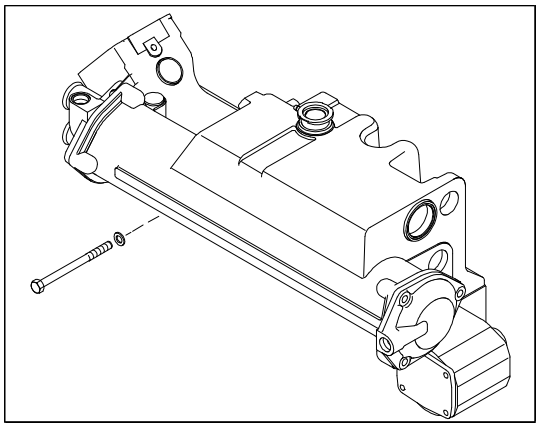
50 Nm +/- 5



08.01 ill.15

Screw, exhaust manifold

23 Nm +/- 2



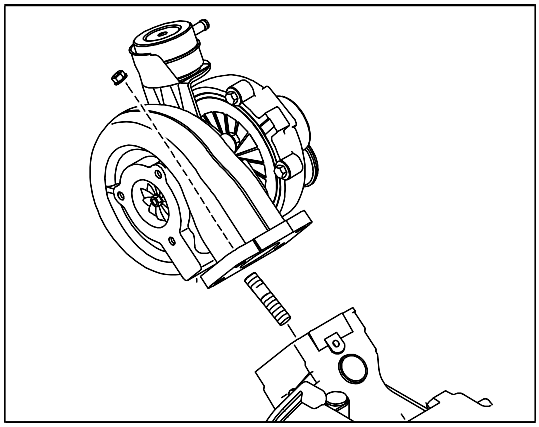
08.01 ill.16

Studs, turbocharger

M8 - 23 Nm +/- 2
M10 - 35 Nm +/-2

Nut, turbocharger
(greased with NEVER SEEZ)

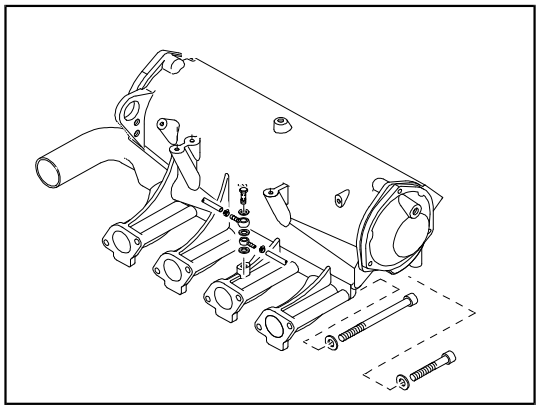
M8 - 25 Nm +/-2
M10 - 45 Nm +/-2



08.01 ill.17

Screws, intercooler

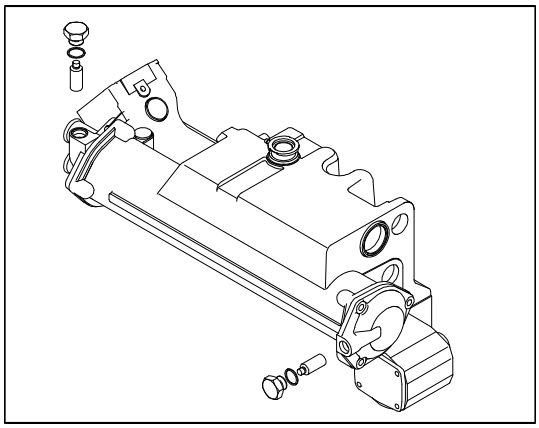
28 Nm +/- 2



08.01 ill.18

Plug screws, zinc anode

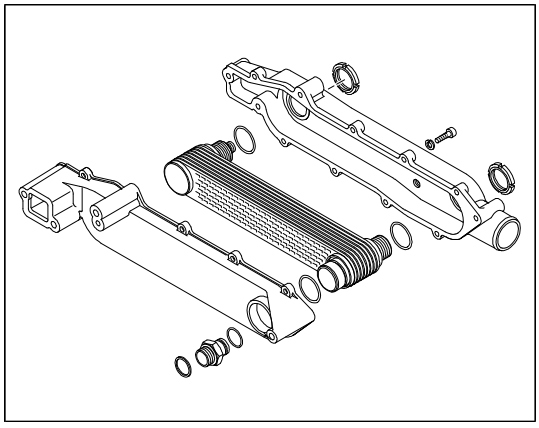
50 Nm +/- 5



08.01 ill.19

Crown nut, oil cooler
(use LOCTITE 243 on thread)

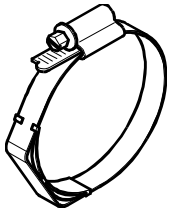
55 Nm +/- 5



08.01 ill.20

NOTE:
for all clamps

3,5 Nm



H 2 General Tightening torques

Values in this table refer to industrial standard and are applicable, if no specific torques are are indicated.
For studs, tightening torques are to be reduced by 50%.

µ tot.	0.125		
	MA in NM		
Property class	8.8	10.9	12.9
Nominal Ø	Metric standard thread		
M 4	2.7	3.88	4.6
M 5	5.5	8	9.5
M 6	9.5	13	16
(M 7)	15	22	26
M 8	23	32	39
M 10	46	64	77
M 12	80	110	135
M 14	125	180	215
M 16	195	275	330
M 18	270	390	455
M 20	385	540	650
M 22	510	720	870
M 24	660	930	1100
M 27	980	1400	1650
M 30	1350	1850	2250
Nominal Ø	Metric standard thread		
M 8x1	25	35	42
M 10x1.25	49	68	82
M 12x1.25	88	125	150
M 12x1.5	83	115	140
M 14x1.5	140	195	235
M 16x1.5	210	295	350
M 18x1.5	305	425	510
M 20x1.5	425	600	720
M 22x1.5	570	800	960
M 24x2	720	1000	1200
M 27x2	1050	1500	1800
M 30x2	1450	2050	2500

If the tightening torque of a screw connection is not reached, the tightness of the screw/nut is too low or the ratio of friction do not correspond. In any case, the screw/nut is to be replaced.

*) µ tot. = total frictional value

H 3 Testing of torque wrenches

The torque wrenches are subject to regular tests of the set values. By doing so, the tripping value of signalling torque wrenches and the scale accuracy of measuring torque wrenches are tested.

H 4 Non-destructive material testing

For the detection of surface cracks, the non-destructive test according to colour penetration test procedure is recommended.
The workpiece is sprayed or coated with a penetration agent, and after drying a developer is applied. After a development time of appr. 10 minutes, defects on the workpiece appear as dots or lines.

H 5 Use of adhesive and sealing materials

In the workshop manual adhesive and sealing materials are specified for the repair of engines and aggregates, which are used at operating temperatures of up to 150° C and agents such as water, coolants and hydraulic fluids, engine and gear oils as well as fuels.

Solvent-free sealing materials

The hardening takes places without loss of volume, so that a retightening of screw connections is not necessary.

Anaerobic sealing materials

These are used for securing, fixing and sealing, and only harden under exclusion of air.

Solvent containing sealing materials

Due to their contents of volatile parts a loss of volume occurs during hardening. During repair, the hardening time is taken into consideration. If such sealing materials are used, special reference is made in the description of the workshop manual.

H 6 Solvent-free sealing materials

Silicon sealing materials

They consist of silicon and filling materials and are free of solvents.
The product is applied to the cleaned sealing surface from the tube or cartridge in form of a string. Sealing material residues are removed with cleaning agent.
Silicon sealing material is to be stored below 30° C.

Anaerobic sealing materials

They consist of a single component epoxy in liquid form. The product is applied as a liquid to the components and remains liquid, as long as it is in contact with ambient air (oxygen). Only when the parts are assembled, chemical reaction starts due to exclusion of air (oxygen) and metal contact, i.e. transformation of liquid state into an epoxy built up by molecular chains.

Any residues remaining after assembly and/or are pressed out of the connection remain liquid and may be removed easily.

General guidelines of application for the of use of anaerobic sealing materials

Cleanliness of components

Non-metallic surface protection must be removed. In case of repair, soiled and oily components are to be cleaned and residues of adhesive plastic material are to be removed. Thread bores are recut with the appropriate thread bore and blown out with compressed air.

If solvents or degreasing agents are used for cleaning, take care that they are completely volatilized before application of the epoxyl.

Storage

At temperatures below 28° C, 1 year minimum.

Guidelines of application for securing (S)

Designation: SM ..... Securing medium tight (the connection is to be loosened without problems)
Designation: SF .....Securing tight (the connection is difficult to loosen)

Application: Screw connections

Fixing procedure

In general, the application of the epoxy to the screw thread is sufficient.
If screws are screwed into socket threads, only the thread bore is wet in order to let the air escape during screwing in.
Screws or nuts which are tightened with a specified torque, are slightly oiled on their support surface or housing part.

Guidelines for fixing (B)

Designation: BM ..... Fixing medium tight
Designation: BF ..... Fixing tight

Application: Jointing connections, bushings, sprockets, belt pulleys, bearings etc.

Jointing procedure

In case of jointing connections both jointing parts are to be wetted. The wetting has to completely cover the jointing surfaces. The parts are shifted into each other by turning, in case of slide fits.

No strength may be exerted to the connection until sturdiness is reached (for time, refer to Table 1).

Guidelines of application for sealing (D)

Designation: DR ..... Sealing of pipe connections
Designation: DF .....Sealing of plane surfaces

Application: Sealing of threads , screw connections, jointing connections and plane surfaces.

Hardening time

Use	Securing		Fixing (B)	Sealing		
Class	SM	SF	BF	DR	DF	DF
Product	Loctite 243	Loctite 262	Loctite 620	Loctite 509	Loctite 510	Loctite 5900
Handtightness reached after	15 - 30 min	15 - 30 min	5 - 10 min	15 - 30 min	immediately	immediately
Functional tightness reached after	1 h	1 h	1 h	0.5 h	immediately	immediately
Final tightness reached after	3 h	3 h	4 h	12 - 24 h	24 h	12 - 24 h

J Wear Limits

Part resp. part union	New part tolerance	Wear Limit	Remark
Main bearing clearance radial Main bearing clearance axial	0,032 - 0,099 0,080 . 0,263	0,15 0,30	
Connect.rod bearing clear. radial Connect.rod bearing clear. axial	0,024 - 0,073 0,064 - 0,217	0,10 0,50	
Cylinder bore	85,00 - 85,01	0,20	
Piston travel clearance	0,071 - 0,099	0,20	
Piston diameter	84,911 - 84,929	0,10	deviation from initial dimension
Gap 1. ring Gap 2. ring Gap 3. ring	0,25 - 0,40 0,50 - 0,75 0,30 - 0,60	1,50 0,25 1,00	
Axial play 1. ring Axial play 2. ring Axial play 3. ring	0,077 - 0,127 0,07 - 0,102 0,03 - 0,065	0,25 0,25 0,15	
Camshaft radial Camshaft axial	0,034 - 0,075 0,096 - 0,230	0,20 0,50	
Valve guide	7,000 - 7,015	0,15	indicates gauging depth up to 3 mm before end of valve guide
Oil pressure idle run Oil pressure rated speed	0,6 - 1,5 4,0 - 7,0	0,50 3,00	
Backlash of teeth oil pump Axial play gear wheel	0,2 - 0,3 0,2	0,80 0,40	

J 1 Adjustment information for service and maintenance

J 1.1 **Engine timing** (measured with dial indicator No. 2300899/0)

Setting instruction: **3,20 +/- 0,04 mm**

Maintenance instruction: In case the measurements are not within the specified limits of **3,14 to 3,26 mm** - than the settings needs to be reset to the original specified value.

J 1.2 **Tension timing belt** (measured with tool VR00515/0)

Tension instruction: **600 +/- 30 N (new belt)**

Tension instruction: ***520 +/- 30 N (used belt)***

Maintenance instruction: In case the measurements are not within the specified limits of **630 N to 490 N** - than the settings needs to be reset to the original specified value.

J 1.3 **Start of fuel delivery on the unit injectors** (measured with dial indicator No. 2300899/0)

Setting instruction: **For original settings on your engine please see table 03. 02. 06**

Maintenance instruction: In case the measurements are not within the specified limits the settings needs to be reset to the original specified value.

J 1.4 **Valve clearance** (measured with tool No. 2300712/3))

Setting instruction: **0,25 mm**

Maintenance instruction: In case the measurements are not within the specified limits less than **0,25 more than 0,30 mm** - the settings needs to be reset to the original specified value.

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